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Slattery

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(54) **ANTENNA CONCEALMENT ASSEMBLY**

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This patent is subject to a terminal disclaimer.

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H01Q 1/42 (2006.01)
H01Q 1/44 (2006.01)
H01Q 1/52 (2006.01)

(52) **U.S. Cl.**
CPC . ***H01Q 1/44*** (2013.01); ***H01Q 1/526*** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/42
USPC 343/782, 788, 872, 873
See application file for complete search history.

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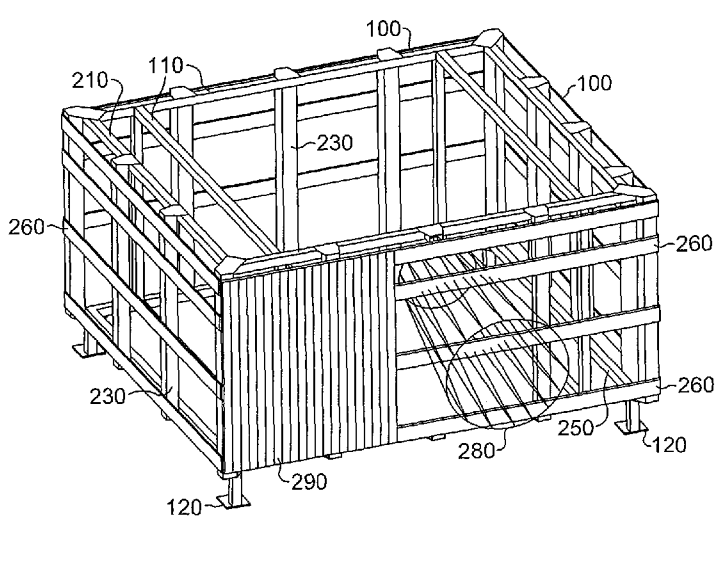
(57) **ABSTRACT**

A rigid antenna support structure is designed and prefabricated to rest on two or more existing support foots normally found on a roof or similar structure. The antenna support structure, to which antennas are attached, possess mounting brackets associated with the exterior of the structure configured to accept a plurality of vertical support members composed of a substantially RF transparent material. Attached to the vertical support members are a number of horizontal support members thereafter forming a concealment assembly skeleton. A plurality of RF transparent panels are then connected to the horizontal support members so as to form a concealment assembly that conceals the antenna support structure and antennas. The concealment assembly is environmentally and aesthetically pleasing, and retains RF transparency so as to not to attenuate the RF signals being sent to or originating from the antennas housed within.

6 Claims, 3 Drawing Sheets



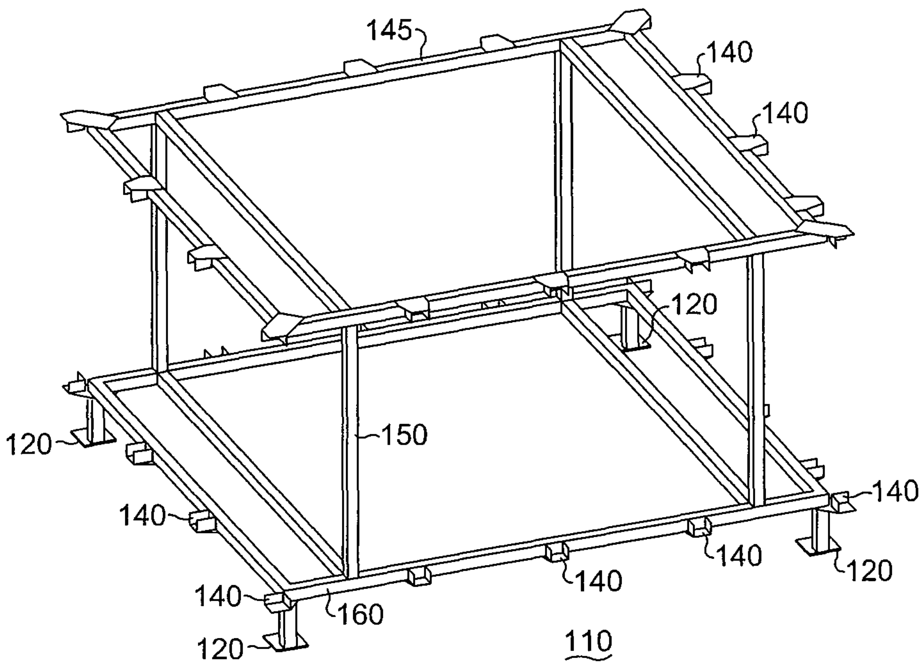

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Fig. 1

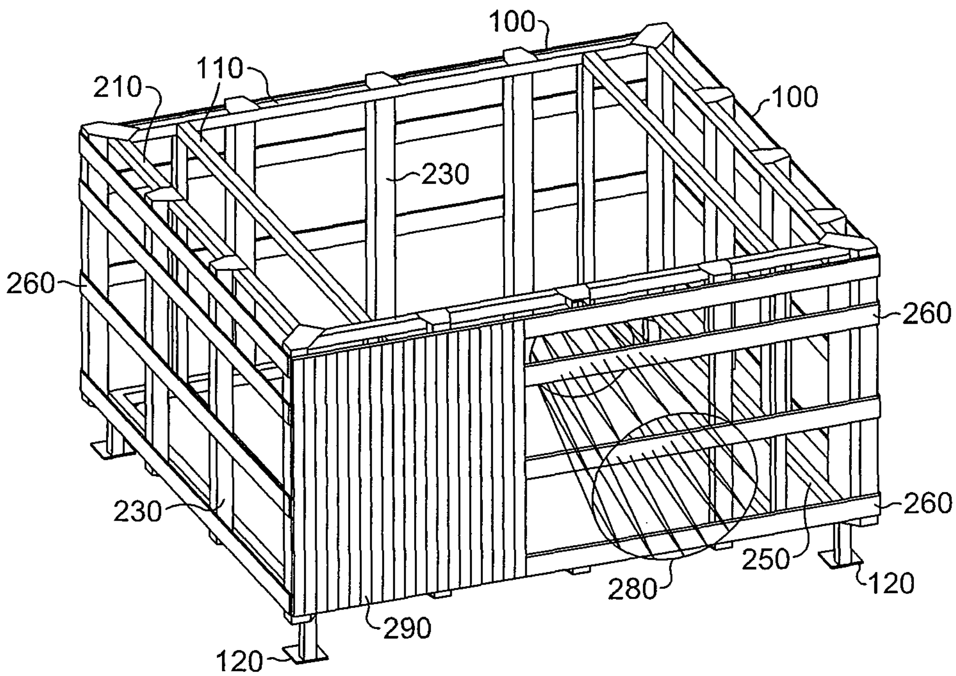
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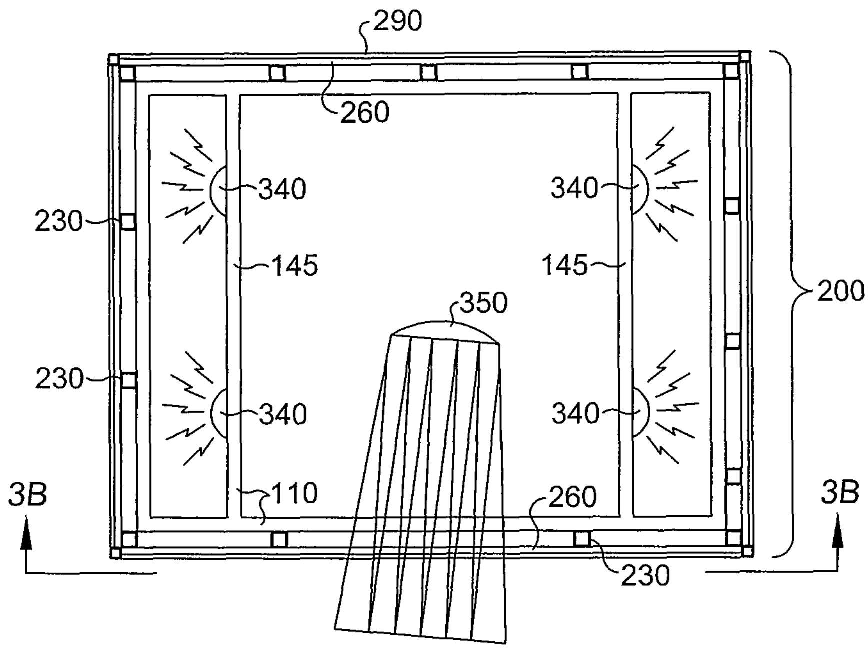
Fig. 2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110
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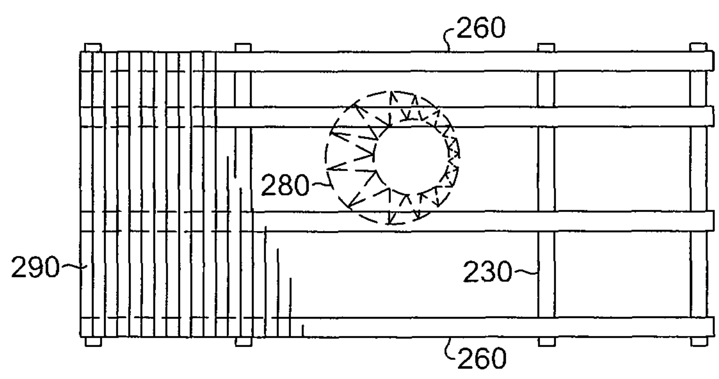
3B
230

Fig. 3A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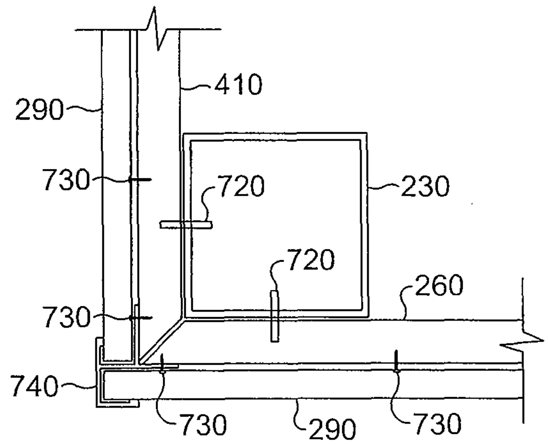
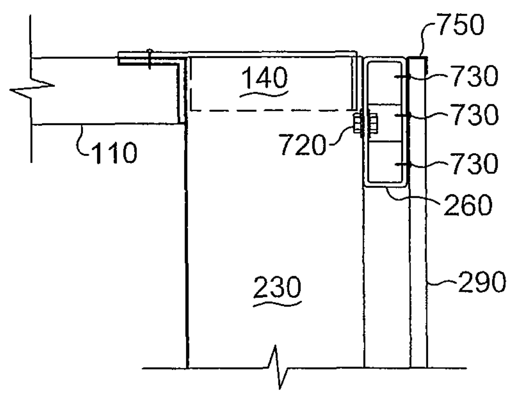
260

Fig. 3B



290
410
730
720
230
720
260
730
740
730
290
730

Fig. 4A



750
140
730
730
720
730
110
260
230
290

Fig. 4B

ANTENNA CONCEALMENT ASSEMBLY

RELATED APPLICATIONS

The present invention claims priority from, and is a continuation application of, U.S. patent application Ser. No. 11/687,469 filed Mar. 16, 2007, which is related to, and claims the benefit of U.S. Provisional Patent Application Ser. No. 60/783,654 filed Mar. 17, 2006, all of which are incorporated herein by reference in their entirety for all purposes as if fully set forth herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates, in general, to RADIO Frequency ("RF") transparent structures and particularly to RF transparent wall structures comprising polyvinyl chloride ("PVC") material formed to visually conceal high frequency and broadband antennas and other RF sensitive devices.

2. Relevant Background

High-speed wireless broadband networks and the like continue to grow in popularity and versatility. Consumer interest in such technology has fueled a need to provide uninterrupted service throughout many regions of the United States. Typically wireless services are limited to a relatively short line of sight range from a local antenna, thus the increased demand has fostered a corresponding demand in establishing numerous antenna structures capable of supporting such RF technology. While the demand for such service continues to grow, the tolerance of unsightly antenna structures associated with such a service has been less than forthcoming. To achieve seamless service in many areas, concealed antenna assemblies are placed on rooftops and other structures throughout the United States and other countries. Recent industry consolidation and government bandwidth auctions has limited the number of licensed carriers to a handful of companies, yet their need for local rooftop antennas continues to grow at an exponential rate. These mega-carriers as they are now referred, have recently entered thousands of US cities and rural areas to expand their cellular, broadband and new 4^{th} generation wireless technology networks.

While the wireless industry expands and upgrades existing networks with new site locations, local Township, City and County municipalities serving these communities are becoming tougher on antenna concealment codes and regulations that prohibit antennas from being mounted on buildings and rooftops without a concealment plan that will blend the resulting structure into the environment.

Concealment of antenna structures is typically done to protect the antenna elements from weather or other harsh environments and/or to meet regulatory requirements. In some applications such as the military, antenna structures and the antennas themselves were camouflaged to reduce the likelihood of detection and destruction. While concealment of cellular and other wireless antenna in a civil setting must meet local environmental constraints, the provider of the cellular service faces economic tradeoffs between aesthetically concealing the antennas so as to meet local ordinances and codes while minimizing the detrimental effects of the concealment assembly on signal strength and the functionality of the antenna.

Prior antenna concealment assemblies have generally been customized structures typically composed of Fiberglass, Fiberglass Reinforced Plastic ("FRP"), Polyurethane Foam, ABS Plastic and/or other composite material. Them materials have offered a reasonable degree of structural integrity and strength as well as reasonable degree of RF transparency for lower frequency cellular applications. Such customized structures and material choices, when implemented on a pervasive scale, are however, less feasible for higher spectrum broadband and satellite applications due to extreme RF transparency requirements.

Architectural and engineering firms typically design custom wireless rooftop sites using steel or similar metallic substances for mating with ballasted frames or structural roof connections from the building. From these connections a frame is constructed to house various antennas. A custom concealment assembly's frame and skin are normally thereafter attached to this steel antenna frame to conceal the antennas. As mentioned, the structure of these existing concealment products, such as the skeleton and external panels, are typically concealed with relatively thick fiberglass or FRP sheathing products.

As demand for cellular and wireless capability continues to grow, so to does the need to install and conceal additional cellular and wireless antennas. A need exists, therefore, to conceal these antennas with a standardized and cost effective concealment assembly that is both economical to produce and install as well as ultra transparent to higher RF used for data rich transmissions. These and other problems recognized in the prior art are addressed by the present invention.

SUMMARY OF THE INVENTION

Briefly stated, the present invention involves systems and methods for concealing wireless antenna while maintaining RF transparency using ultra-thin materials. The present invention uses a combination of maintenance-free, RF transparent, and structurally rigid prefabricated Polyvinyl Chloride (PVC) members to conceal an antenna structure. A rigid antenna support structure is designed and fabricated to rest on an existing ballasted antenna frame or on two or more existing support foots normally found on a roof or similar structure. The existing antenna support structure, to which the antennas are attached, possess mounting brackets or other direct points of attachment associated with the exterior of the structure configured to accept a plurality of vertical prefabricated support members composed of a substantially RF transparent material.

Attached to the vertical support members are a number of substantially RF transparent horizontal support members forming a concealment assembly skeleton. This skeleton, which is attached to the antenna support structure, is, in one embodiment, constructed from hollow PVC extruded material and is prefabricated based on a predetermined design of the antenna support structure for quick and economical on-site assembly.

A plurality of RF transparent interlocking PVC panels are connected to the horizontal support members so as to form a wall concealment assembly that conceals the antenna support structure and antennas housed within. The resulting assembly is environmentally and aesthetically pleasing and retains RF transparency so as to not to attenuate the signals being sent to, or originating from, the antennas.

Additional advantages of the present invention will be set forth in the description which follows and will be obvious from the description, or may be learned by practice of the invention. The advantage of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive to the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned and other features and objects of the present invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of a preferred embodiment taken in conjunction with the accompanying drawings, wherein:

FIG. **1** shows a perspective view of a cellular antenna support structure possessing mounting fixtures for a prefabricated concealment assembly according to one embodiment of the present invention;

FIG. **2** shows a perspective view of the cellular antenna support structure for a prefabricated concealment assembly showing one orientation of antenna components in comparison to vertical support members of the concealment assembly according to one embodiment of the present invention;

FIG. **3** shows a side and top view of a cellular antenna concealment assembly **100** according to one embodiment of the present invention; and

FIG. **4** shows side and top view of the joining and attaching mechanisms and orientation of support members of a prefabricated concealment assembly according to one embodiment of the present invention.

The Figures depict embodiments of the present invention for purposes of illustration only. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the invention described herein.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Exemplary embodiments of systems and methods for concealing RF antennas with RF transparent material, as are illustrated in the accompanying drawings, are hereinafter presented. Consistent with the general principles of the present invention, an antenna concealment assembly **100** is presented that conceals one or more RF antennas with an assembly composed of RF transparent material.

FIG. **1** shows a perspective view of a wireless antenna support structure **110** possessing mounting fixtures for a prefabricated concealment assembly according to one embodiment of the present invention. As can be appreciated by one skilled in the relevant art, most building roofs are either flat or gabled. A cellular or wireless antenna support structure **110**, as shown in FIG. **1**, provides a means by which the support structure can be attached to existing roof support points capable of structurally supporting the antenna and concealment assembly. These structural attach points vary depending on the particular environment, roof, or building on which the antenna support structure **110** is installed. The building's roof design and the size and weight of the steel antenna frame, with attached concealment members and panels, will dictate if a ballasted or roof mounted product is possible. In most cases, the requirement will be for the frame and concealment assembly to be structurally mounted directly to the building's roof. In other embodiments, and without departing from the scope of the invention, the antenna support structure can be attached to a supporting structure separate or independent of a building or roof.

As shown in FIG. **1**, the antenna support structure **110** includes both horizontal and vertical members as required to support the antennas begin housed within the structure. In the embodiment depicted in FIG. **1**, a rectangular structure possessing four attachment points **120** for attaching the antenna support structure **110** to the underlying structural building are evident. According to one embodiment of the present invention, the antenna support structure includes an inner and outer support ring. The inner support ring or structure is associated with the housing and mounting of the antennas. In the embodiment shown in FIG. **1**, two opposing inner support structures are provided for housing and attaching various antenna. The outer support ring is configured to allow the transmitting side of the antenna to face outward from the inner ring and yet be concealed by the concealment assembly **160** attached to the outer ring. Associated with the outer support ring are upper and lower cross members **145** that house a plurality of mounting platforms **140**. The mounting platforms **140** are, in one embodiment of the present invention, oriented along the horizontal members of the antenna support structure **110** that comprise the outer ring. In other embodiments, the support structure may be of other shapes such as cylindrical or triangular based on the underlying antenna configuration.

As shown in FIG. **1**, mounting platforms **140** are positioned on horizontal cross members **145** of the external antenna support structural **110** ring in a manner to accept vertical support members of the concealment assembly **100** as will be subsequently described.

In one embodiment of the present invention, an adjustable square, tubular steel frame **160** comprising four or more structural roof attachment points **120** is prefabricated so as to allow the structure's **110** steel frame and attachment points **120** be adjusted in advance or in the field for a structural connection. Above those points, the remaining components of the antenna support structure **110** and concealment assembly **100** are interchangeable and independent of the roofs contact points.

Once the roof frame measurements have been determined and the antenna support structure **110** roof attachment points **120** are adjusted accordingly, additional vertical connection members **150** and corresponding cross members **145** can be constructed. The mounting platforms **140** can thereafter be attached to the upper and lower cross members **145** as required for each individual configuration. In one embodiment of the present invention, and as shown in FIG. **2**, the various mounting platforms **145** include both corner mounting platforms and mid-member mounting platforms. The mounting platforms are spaced along the cross members **145** as required to provide adequate structural support for the concealment assembly **100**.

The present invention's pre-engineered and prefabricated concealment assembly is independent of the variable steel roof mount dimensions from individual sites, and therefore can be produced with greater efficiencies with maintenance free, UV protected materials. These materials can be produced in multiple colors as well as optional faux stone or brick digital wallpaper coverings to match existing buildings. The present invention can be shipped to the site as individual wrapped pieces as a knock-down kit with assembly instructions, or it can be fully assembled at the fabrication factory and shipped to the cellular construction site as a completed unit ready to be hoisted and attached to the roof mounts. Because the antenna support structure **110** can be adjustable, the on-center distance between each vertical support **150** is determined by the design and specifications of the antenna concealment assembly **100**, not by a roofs variable connection points.

FIG. **2** shows a perspective view of a cellular antenna support structure **110** for a prefabricated concealment assembly **100** showing one orientation of antenna components in comparison to vertical support members **230** of the concealment assembly **100** according to one embodiment of the present invention. As previously mentioned, the antenna support structure **110** possesses an internal ring or structure configured to house the antenna and an external structure configured to house the concealment assembly. While in ideal conditions the antenna support structure **110** would also be composed of RF transparent material, the orientation of each antenna mitigates the impact of any interference caused by the antenna support structure **110** while maximizing the importance of the RF transparency of the concealment assembly **100**.

FIG. **2** further depicts, according to one embodiment of the present invention, a plurality of vertical support members **230** fixed to various mounting platforms **140**. Each vertical support member **230** is accepted into a mounting bracket of an upper and lower mounting platform **210**, **250**. Once received by the mounting platform **210**, **250**, the vertical support member **230** is fixed to the platform using a RF transparent fastener. The vertical support members **230** are positioned along the antenna support structure **110** as necessary to bear the weight of the concealment assembly **100**. In one embodiment of the present invention, each vertical support member **230** is composed substantially of hollow PVC material with walls of the vertical support member ranging between 0.120 and 0.270 inches in thickness. PVC possesses the inherent qualities of being substantially RF transparent in the 3 kHz to the 300 GHz range while providing adequate structural strength to support the concealment assembly. Furthermore, the well established manufacturing process of PVC products enable components such as the vertical support member **230** be to economically produced.

As shown in FIG. **2** and according to yet another embodiment of the present invention, horizontal support members **260** are attached to the vertical support members **130** to produce several concealment assembly cross members. As with the vertical support members **230**, the horizontal support members **260** are composed of a material that is substantially RF transparent. In one embodiment of the present invention, the horizontal cross members **260** are fashioned out of hollow extruded PVC possessing a wall thickness between 0.080 and 0.095 inches. As will be appreciated by one skilled in the art, other material that is substantially RF transparent and offers adequate rigidity and strength to support a concealment assembly is within the scope of, and is indeed contemplated by, the present invention. The present invention's RF transparent PVC members and panels have a dielectric constant in the range of 2.0 to 3.0. This dielectric constant is very comparable to the fiberglass products used today in customized antenna concealment structures. However, the fiberglass materials, due to their lower overall rigidity and strength, are generally engineered to be much denser and thicker than the present invention's PVC members and panels. Therefore the present invention provides a significant decrease in RF loss or attenuation over materials and designs of the prior art. It is also to be understood that although the invention has been described and illustrated with a certain degree of particularity, the present disclosure is made only by way of example, and that numerous changes in the combination, composition, and arrangement of parts can be resorted to by those skilled in the art without departing from the spirit and scope of the invention.

As is further illustrated in FIG. **2**, the horizontal support members **260** and vertical support members can be positioned so as to minimize the volume (total thickness) of concealment material (structure) through which the transmission cone **280** must pass. The positioning of the structure is based on projected wind and other structural loads and the inherent strength of the vertical and horizontal support members combined with the rigidity of the concealment panel **290** which complete the concealment.

The concealment panels **290** are, in this embodiment of the present invention, prefabricated and interlocking to match the outside dimensions of the antenna support structure **110** with the vertical support members **230** and the horizontal support members **260** in place. Accordingly, once the initial dimensions of the attaching points **120** of the antenna support structure **110** are known, the remaining components of the antenna concealment assembly **100**, and for that matter the antenna support structure **110**, can be prefabricated offsite and mounted on the attachment points **120** quickly and with minimal, if any, customization.

Each concealment panel **290** is composed of a material that is substantially RF transparent such as PVC with a thickness of substantially between 0.025 and 0.050 mm. Based on the positioning of the vertical and horizontal support members **230**, **290**, the concealment panel can be prefabricated to possesses structural channel to enhance rigidity without significantly impacting its RF transparency. In addition, each panel can be fabricated to provide an exterior appearance consistent with the surrounding environment. For example, the exterior surface of the panels **290** can resemble a brick facade or be fashioned to resemble wood siding. Indeed in one embodiment of the present invention, concealment panels are corrugated to aid in flexibility as well as ventilated to mitigate aerodynamic forces imposed on the antenna concealment assembly **100** due to wind forces. In an exemplary embodiment of the present invention, the concealment panels **290** are connected to the horizontal support members **260** using a plurality of RF transparent clasps. The clasps are used to connect the panels **290** using predrilled holes that align with receiving holes in the horizontal support members **260**. In yet another embodiment of the present invention, the clasps used to connect the panels **290** to the horizontal support member **2600** are of a self-locking nature that allow for quick and permanent coupling of each panel **290** to the corresponding horizontal support member **260**.

FIG. **3** shows, according to one embodiment of the present invention, a top and side view of an antenna support structure **110** possessing a concealment assembly **100** attached to the structure's exterior. The top view of the concealment assembly **100** shows the antenna support structure **110** to the interior of the concealment assembly **100**. Vertical support members **230** are attached to the outside of the antenna support structure **100**, so as not to interfere with the positioning and orientation of the antenna **340** mounted on the interior portions of the antenna support structure **110**. In the embodiment shown in FIG. **3**, two sets of two antenna **340** are positioned spanning between an upper and lower inner cross members **145**. The antenna **340** are respectively oriented outward away from the inner antenna support structure **110** and toward the concealment assembly **100**. The orientation of these antenna **340** serve to illustrate the need to ensure that the concealment assembly **100** is composed of a material that is substantially RF transparent. Furthermore, a centralized antenna **350** is directed toward a wall designed to minimize structural component interference. Connected to the outside of the vertical support members **230** are the horizontal support members **230** and the concealment panels **290**.

The side view of the concealment assembly **100**, also shown in FIG. **3**, shows one embodiment of a configuration of vertical and horizontal support members **230**, **260** that are used to ultimately house the concealment panels **290**. The fence-like structure is fashioned based on a particular application. Those applications or concealment projects likely to be placed in an environment subject to severe environmental conditions may necessitate a stronger structure. The number and spacing of the vertical and horizontal support members **230**, **260** can be varied depending on individual applications balanced with the need for RF transparency.

FIG. **4** shows a top and side view of one embodiment of components of the concealment assembly **100** in a final assembled configuration. Looking first at the side view, a mounting platform **140** coupled to the antenna support structure **110** houses the top end of a vertical support member **230**. The vertical support member **230** is joined to a horizontal support member **260** via a RF transparent fastener **720**. In one embodiment of the present invention, portions of the vertical support member **230** and/or the horizontal support member **260** are removed to provide access to prefabricated openings used in conjunction with the appropriate fasteners **720**. Attached to the horizontal support members **260** via RF transparent clasps **730**, or other fastening means, are RF transparent panels **290**. Again, the openings used to accept the various clasps **730** and fasteners **720** are prefabricated to facilitate quick and economical on-site construction. Also shown in FIG. **4**, and according to another embodiment of the present invention, is an overhanging J-channel **740** that affixes to the horizontal support member **260** and allows the RF transparent panel **290** to be inserted and coupled to the horizontal support member without necessitating any type of clasp or fastening device.

The top view of a final assembly of components of the concealment assembly **100** provides additional insight as to the construction and design of one embodiment of the present invention. This top view shows a corner of a concealment assembly **100** having a vertical support member **230** joined to two horizontal support members **410** to which two RF transparent panels **290** are attached. Significantly, this depiction shows that in one exemplary embodiment of the present invention, the vertical support members **230** are hollow columns. FIG. **4** depicts the vertical support member **230** as a square column with a void central region. This type of hollow construction increases rigidity and strength of the member while preserving a low overall material density. Material density is directly related to RF transparency and thus a design using hollow structural members is a significant advantage of the present invention.

As shown in FIG. **4**, two horizontal support members **260**, also possessing a central region void of material, are joined to the vertical support member **230** using RF transparent fasteners **720**. RF transparent panels **290** are thereafter attached to the horizontal support members **260** forming the concealment assembly **100**. The embodiment shown in FIG. **4** depicts a mitered corner whereby the two horizontal support members **260** are joined. The RF transparent panels **290** coupled to each horizontal support member **260** forming an overlapping corner configuration. In this embodiment, an RF transparent trim or cap such as J-channel **740** is used to frame and capture the panels **290** along the concealment assembly's edges to provide a finished, maintenance-free appearance.

The entire assembly comprising the vertical support members **230**, the horizontal support members **260**, the RF transparent panels **290**, and the RF transparent fasteners provide a structurally sound concealment of RF antenna while minimizing the material density and thus the interference associated by such a concealment assembly. By using components composed substantially of PVC, the overall RF transparency of the concealment assembly **100**, especially high component in regions of the assembly such as corners, is considerably below that of concealment assemblies known in the prior art.

As was previously suggested, the assembly and creation of the concealment assembly **100** is efficient and economical. As a detailed illustration of this process, the following step-by-step process is provided to aid the reader in gaining a full understanding of the scope of the present invention.

Once the antenna support structure **110** is erected on the site, or, alternatively, the exact dimensions of the antenna support structure are known, the components of the concealment assembly **100** can be fashioned. These components are then delivered to the site for assembly. One should note that in an alternative embodiment of the present invention, the entire concealment assembly **100** can be assembled off site and transported to the final resting place for placement on the roof's structural supports. In an exemplary embodiment of the present invention, the vertical support members **230**, are arranged and positioned between each of the corresponding mounting platforms **140** and attached securely with self tapping screws. Once the vertical support member **230** skeleton is erected between top and bottom mounting platforms **230**, pre-cut and routed horizontal support members **260** are attached. The horizontal support members **260** are individually spaced down and across the vertical support members **230** (based on the pre-engineered on-center requirements) from the top of assembly **100** to the bottom of the assembly **100**), depending on the structural characteristics of the horizontal support member **260** as combined with the concealment panel **290**.

Pre-drilled holes in the vertical support members **230** match up exactly with pre-drilled holes in the horizontal support members **260**. As mentioned above, access holes drilled into the non-touching walls allow the RF transparent bolts and nuts to be tightened down, connecting the vertical support members **230** securely to the horizontal support members **260**. These access holes are later hidden by the RF transparent panels **290**.

After attaching each row of horizontal support members **260** to corresponding vertical support members **230**, the completed concealment assembly **100** skeleton is now ready to accept RF transparent panels **290**. RF transparent accessory trim is then used to frame the unit along the outer facing edges of the horizontal support members **260** and RF panel **290** junctures.

In one embodiment of the present invention, unique RF transparent nylon push pins **730** having a barbed edge are inserted into the panel **290** horizontal support member **260** combination to secure each panel **290** to corresponding horizontal support member **260**. The push pins **730** secure the RF transparent panel **290** to the horizontal support members **260**, and provide the concealment assembly **100** with additional engineered strength to meet rooftop wind loads.

The push pins **730** snap open inside the hollow horizontal support member **260** securely and structurally fastening the panel **290**. This building process moves along horizontally as panels are inserted and connected to the previous panel, then vertically along each horizontal support member **260** until the concealment assembly unit **100** is completed.

Depending on the required concealment plan, an additional layer of the outdoor faux stone or brick digital vinyl wallpaper may be applied to the external sheathing in order to match the exact brick or stone pattern used on the original building.

In yet another embodiment of the present invention, a removable door panel (if applicable) is installed to permit access to the antenna and internal structure. In another embodiment of the present invention, the entire completed concealment assembly **100** can be shipped as a completed antenna concealment unit with steel frame, PVC skeleton, and panels attached.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various other changes in the form and details may be made without departing from the spirit and scope of the invention. It should be understood that this description has been made by way of example, and that the invention is defined by the scope of the following claims.

I claim:

1. A method of using a polyvinyl chloride material to conceal a radio frequency ("RF") antenna, consisting of:

forming an RF antenna enclosure, wherein at least a portion of the enclosure that is in direct interaction with a main lobe of a divergent radiation pattern consists solely of a single corrugated planar extruded polyvinyl chloride panel having a varied profile and wherein the single corrugated planar extruded polyvinyl chloride panel is substantially transparent to radio frequencies ranging from about 3 kHz to about 300 GHz.

2. The method of claim **1** wherein the varied profiled of the single corrugated planar extruded polyvinyl chloride panel repetitively varies angular interaction between the single corrugated planar extruded polyvinyl chloride panel and the main lobe of the divergent radiation pattern of the RF antenna.

3. The method of claim **1** wherein the single corrugated planar extruded polyvinyl chloride panel is supported by two or more support structures and interaction between the main lobe of the divergent radiation pattern and the single corrugated planar extruded polyvinyl chloride panel is unmitigated by the support structures.

4. An antenna concealment assembly, the assembly consisting of an enclosure concealing a divergent Radio Frequency (RF) antenna, wherein at least a portion of the enclosure that is in direct interaction with a main lobe of a radiation pattern of the RF antenna consists solely of a single, substantially planar, extruded polyvinyl chloride corrugated panel having a varied profile supported between a span formed by two or more supports wherein the single, substantially planar extruded polyvinyl chloride corrugated panel is substantially transparent to radio frequencies from about 500 kHz to about 100 GHz.

5. An antenna concealment assembly, consisting of:

an enclosure that conceals a radio frequency ("RF") antenna, wherein at least a portion of the enclosure that is in direct interaction with a main lobe of a divergent radiation pattern consists of a single, substantially planar, corrugated polyvinyl chloride extruded panel wherein the single substantially planar corrugated polyvinyl chloride extruded panel includes a dielectric transparency factor inversely proportional with thickness and a rigidity factor directly proportional with a corrugation factor and wherein a combination of the dielectric transparency factor and the rigidity factor for the substantially planar corrugate polyvinyl chloride extruded panel is optimized.

6. The assembly of claim **5** wherein the at least one corrugated polyvinyl chloride extruded panel is fabricated such that the panel has a thickness that maximizes transparency to radio frequencies ranging from about 3 kHz to about 300 GHz.

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